WATER CORPORATION OF WESTERN AUSTRALIA

GOLDFIELDS AND AGRICULTURAL WATER SUPPLY HISTORY PROJECT

Transcript of interviews with

BRUCE W. S. JAMES

State Electricity Commission electrical engineer; born in 1928 in Edinburgh, Scotland, educated at Wesley College and the University of Western Australia (BE 1951), joined State Electricity Commission in 1951 as assistant engineer in the South West District (Bunbury) working on the South West Electricity Scheme, District Engineer South West District (1956-68), Assistant Country Transmission and Distribution Engineer in Perth (1968-75), Central Engineering Services Engineer (1975-81), Manager Operational Services (1981-87).

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BRUCE WILLIAM STODDART JAMES

BIOGRAPHICAL NOTES

Bruce W. S. James OAM was born in Edinburgh, Scotland, on 18 September 1928 and spent the first four years of his life in Malaya before returning to the United Kingdom in 1933 to start his schooling. He came to Western Australia in October 1940 and completed his secondary schooling at Wesley College (1940-45) before entering the University of Western Australia (UWA) where he studied electrical engineering and graduated as a Batchelor of Engineering (1951). During the first two university long vacations he worked for the Metropolitan Water Supply, Sewerage and Drainage Department (Perth, 1946-47) and in the UWA Mechanical Engineering Department (1947-48). During the period of work experience in the penultimate year of his course James worked for the Metropolitan Water Board (London) on the construction of the Lea Valley Reservoir and in the works of W.H. Allen & Sons (Bedford), manufacturers of electrical motors and generators. James was Captain of the University Boat Club and was awarded a University Half Blue for rowing in 1948.

On the completion of his degree course he joined the State Electricity Commission as an assistant engineer under the direction of the District Engineer for the South West Power Scheme based at Bunbury (Picton). The South West Scheme was officially opened later that year in August 1951 when the Collie Power Station began supplying the South West system. James was engaged in the changeover of the electricity supply of Busselton and a number of other towns from local authority Direct Current supply to SEC Alternating Current supply and in the design and construction of local distribution power lines and high voltage transmission lines including the 122 km long 66kV line from Bunbury Power Station to Cannington (Perth). In November 1956 James was appointed District Engineer, South West, and was responsible to the Perth-based Engineer-in-charge, South West System, for the maintenance and extension of the electrical transmission and distribution system within the South West and Great Southern areas of Western Australia. This included the development of new and improved engineering systems such as the first aerial patrolling programme for the inspection of high voltage transmission lines.

He was transferred to the Perth Head Office in March 1968 to become Assistant Country Transmission and Distribution Engineer in which position he was engaged in the provision of electricity supplies outside the Perth Metropolitan Area extending from Kunurra to Esperance. His activities included the preparation of a ten year plan for the development of the Country System High Voltage Network and of the necessary associated annual budget estimates.

In July 1975 James was appointed acting Executive Engineer of the SEC's Central Engineering Services Group and, after a year in an acting position, in July 1976 he was appointed Central Engineering Services (CES) Engineer. The CES Group covered a wide range of the Commission's activities apart from its power design and generation functions and included such diverse activities as the operation of the Commission's diesel powered country power stations, the operation of its civil, electrical and maintenance workshops and construction work, the Commission's motor vehicle and mobile plant fleet and its electrical measurement and testing workshops. James was responsible for over a thousand SEC personnel working within the CES Group, amounting to approximately 20 per cent of the Commission's total workforce. In 1981 he moved from the provision of engineering services to become Manager, Operational Services. In addition to the operational activities of organisations in the CES Group, James was also responsible for the

establishment and operation of a maintenance programme for the Commission's 330 kV, 220 kV and 132 kV main transmission lines. He retired in September 1987.

He has been an active member of the Institution of Engineers, Australia (Member 1956, Fellow 1973) and was Chairman of the Western Australian Division (State President) in 1987-88. He was made an Emeritus Member of the Electrical College of the Institution in 1997 and was Chairman of the Division's Engineering Heritage Panel for ten years (1993-2003). In November 1999 he was made an Honorary Fellow of the Institution. He has also been actively associated with the Institution of Electrical Engineers (Member 1957, Fellow 1974) and was a member of its Western Australian Committee (1971-2003) and was that committee's chairman in 1978-90. He was appointed to the Heritage Council of Western Australia for the period 1993-98 during which time he was a member of the Council's Register Committee. He was awarded the Council's Certificate of Merit in 1998. He represented the graduate body of the University of Western Australia on the University Senate in 1896-92. He was awarded the Medal of the Order of Australia in 2001.

Bruce James married Helen Williams in 1952. They have three sons and live in Applecross.

BRUCE JAMES

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RGH January 2003.

GOLDFIELDS WATER SUPPLY HISTORY
Interview with Bruce James
on 13th September 2002 at Applecross, Western Australia
Interviewer: Richard G Hartley

RH This is Richard Hartley speaking. I am talking to Bruce James this morning on Friday, 13th September 2002 {laughter} – don't laugh - about the power supplies to the electrified pumping stations. Good morning Bruce.

BJ Good morning Richard.

RH The first pumping station was electrified in 1954 – that was the Mundaring one. That was fairly soon after the South Fremantle Power Station came into operation.

BJ Yes, yes.

RH Were there any problems in providing an uninterrupted supply?

BJ I would have no idea of any problems there. I was based in Bunbury at the time, tied up with the country system, and had nothing to do with that. I am afraid I can't help you with that particular one, but I wouldn't have thought there would have been many problems in that area. It was an isolated supply and relatively close to the generating stations at East Perth and South Fremantle.

RH Yes. They had to build a yard at Mundaring, didn't they? When was that built, when they put the electrical pumps in?

BJ I would think it was. Again, I have no knowledge of the details of it – how and when. I don't even know what the voltage was that they supplied.

RH Are you implying that as you got further away from [the generating stations] the problems became more difficult as far as the SEC was concerned? Is that correct?

BJ It wasn't a case of getting more difficult. The point was we had certain other considerations to look at. The cheapest way to start a squirrel cage wound motor – that is, [one in which there] are no commutators, it is just a self-contained unit - is to put it straight on line.

RH Yes.

BJ And if my memory serves me right, the in-rush current is something like six times full load current.

RH Is it really?

BJ So you get this initial very large in-rush current going in until the motor picks up speed and load and away it goes. The excepted -- let's put it another way -- the statutory fluctuation in voltage that was allowed at the consumers' terminals was plus or minus six per cent. We were working on a 250 volt single phase / 440 three phase in those days, [although] those figures are not mathematically correct. 440 should really be associated with 254, not 250.

Note: Transcript is verbatim except for minor editing which is indicated by squared brackets thus [ ]

RH You have lost me a bit there.

BJ Three phase.

RH Yes.

BJ Three phase power – you have three wires, and you have 440 volts between any two of those wires.

RH Oh yes.

BJ But between any one of those wires and ground, or neutral – the neutral point – is only 250. In actual fact, it's 440 divided by root 3.

RH Oh yes.

BJ And when you divide 440 by root 3, it actually comes to 254.

RH Oh, I see what you mean. Yes.

BJ But the Act was printed, 440/250, a mathematical impossibility! [laughter]

RH Yes!

BJ But it was never questioned in a legal court as to whether the ten per cent was on the 440 or the 250 but, as most houses had 250 volts, it was plus or minus ten per cent [of that]. But, on top of that, there was an accepted practice that the flicker voltage – that is the sudden flicker voltage – was to be limited to three per cent. A sudden change of voltage, no more than three per cent. Now when we start these large motors, it's the three per cent that we are concerned with – this flicker voltage. Because, otherwise your television picture starts to shrink and you get a lot of problems there. Lights flick and otherwise.

RH Yes.

BJ So, as the different pumping stations were being designed, as they went further away from Perth, closer to Kalgoorlie, so the length of line – or the distance – from the power stations increased and – I am going to use the word, the electrical term, impedance – the impedance of the circuit or its resistance, if you like to call it – it's not actually resistance -- is in phase with the voltage, but the resistance increases. The total resistance increases. So what we had to design, and what my job was when I became second in charge of the country system – was to tell the Public Works -- Bob Pritchard and his men -- that at a certain point on the line – Kellerberrin, Southern Cross, or wherever it might be – wherever these new pumping stations were going in, [whether they] were taking over from the steam [pumping stations or whether they] were booster stations in between the steam stations -- I had to tell him what the maximum current he was allowed to draw for whatever sized motor that he had to put in.

Now, in a lot of cases, this meant that he could not use a squirrel-cage motor, either direct on line or with a Star Delta starter. Star Delta starter connects the windings ... connects the voltage, the windings of the motor across the 250 voltage ...

RH Yes.

BJ ... which means you get a much lower starting current, say six times 250 than you would at 440 and when the thing has built up a bit of speed, then you switch them over to the other one. When you get above that, those two requirements, because the motors are greater, you've then got to have wound rotor motors with commutators, and you've got to be able to take out and put resistances in. Resistance starters. And ...

RH That's resistance to keep the total load down, is it?

BJ Keep the total load down. To keep the voltage down on the windings.

RH Yes.

BJ Keep the voltage down on the motor and, hence, the in-rush current is much lower. If you put a low voltage in, you will only get a low current and it will slowly build up speed. For the motors they had to purchase and specify technical tenders for, they had to to include the necessary starting gear to limit the current to, say, 400 amps or 600 amps or whatever it was. Now this depended again on the voltage at which we were selling the power, or they were taking the power for the particular pumping station. Now they might have taken it at low voltage – 440 volts – which is now 420, I might add. It has dropped now because we've standardised. It may have been at 3000 volts, 3300 or 6600, according to the size of the motors because, in most cases – or in a lot of cases – not necessarily in most cases, in a lot of cases, where the very big pump stations were, we were able to give them their own transformer. So that no-one else was affected by it.

RH Yes. What voltages were the supplies transmitted at? What voltage did the transmission lines carry?

BJ Initially, the line went up at 66,000 volts, from Perth. Then it was changed to 132,000– there was an additional line brought in at 132 kV, part way along, and more recently the line to Kalgoorlie from Muja goes in at 220 kV and taps in at Merredin. So you've got a direct link there without having to come up all the way through the lower voltage lines.

RH So the one that went up to Merredin, for instance, in the first place, what was that voltage?

BJ That would have been 66,000 volts.

RH Oh. And so was that directly from 66,000 down to whatever you wanted it at – 3000 or ...

BJ 66 down to 22 kV.

RH Oh.

BJ 22 kV was our distribution voltage.

RH Oh, I see, yes.

BJ The high tension – as it is in Perth.

RH Yes.

BJ In actual fact, if you look at the picture of the state, the south-west land division in general, closer to the metropolitan area, the distribution voltage was 22,000 volt and then, when we got to the outback, it was 33,000.

RH Yes.

BJ Now, it wasn't so much [because] of the towns, it was [to suit] rural electrification. 22,000 over root 3 is 12.7 and for 33kv is 19.1. So the single phase lines that we ran out to the farming areas, which went out for, well, sometimes hundreds of kilometres, kilometres or lengths of line, we could go much further with the same sized wire – 33 here, or 19.1 rather than the 12.7.

RH So they were single phase as opposed to the three phase.

BJ The farmers were basically single phase.

RH Oh, were they?

BJ And they were allowed up to, basically, 10 KvA load on any one motor. There were occasions when we put two transformers in and they could do it. As the system grew, the backbone feeder into a rural area could be three phase, but all the customers on it – even along that line itself – the farming customers, were single phase. Things have changed. For example, if you take the line out to Denmark and Walpole, Nornalup-Walpole, now, instead of being dairy farmers and small rural holdings, we've got vineyards with big water pumps.

RH Oh yes.

BJ Each of those – although the feeder is a three phase feeder – we will have connected those pumps as three phase pumps, as long as we didn't have to go too far. But it's that flicker voltage that was the important thing that we had to allow for so that the in-rush starting current on those motors did not get too big.

RH You didn't have to start too many at the same time, I guess, too?

BJ Well, they were fed off different ports, and I don't think they normally synchronised them so that they all started together.

RH They did in the old days in the steam business because, when they didn't pump overnight, they started them all eight o'clock in the morning when the reports came through from Kalgoorlie as to how much water they wanted.

BJ Yes.

RH But that's different. By the time they got to electrification, they were pumping all day anyway.

BJ Well, then there were changes in tariff. I don't know whether there was a special tariff for the Water Corp. or Goldfields Water Supply Scheme, but when the country system started, it didn't matter who you were, the first 72 units a quarter were at seven pence. The next 72 were at six pence. The next, up to ... oh, what was it ... 700 units or something were at five pence and everything else was at four pence. And there was a minimum charge for very, very small customers. Now I was in

Bunbury. That was the standard tariff for town and farming. It was what the coalmines in Collie paid – they were on exactly the same tariff.

RH Oh, were they?

BJ *Everyone* was on the same tariff, and that didn't matter whether ...

RH Whatever the generating source.

BJ It didn't matter whether you used the power at night, or in the morning, or day, at peak load, in the weekend or otherwise. Everyone paid the same. It was such a simple – ultra simple tariff. Later on, that changed, and the increments increased according to the cost of living and a few other things, but it got to the stage where some of the larger customers, and I am almost certain that the Water Corporation was one – from talking to Pat Turner – and that the pipeline people had a tariff that allowed them a cheaper rate at night.

RH Yes, that's right.

BJ And a higher rate during the day, and what he had to do – and his big problem was – was to look ahead at the weather forecast for about four or five days, and then see how much capacity he had in his different reservoirs, estimate what the draw off was going to be and then pump as much as possible during the night, and if he couldn't get enough through in the night time at the low tariff rate and weekend rate – the low tariff rate – then he had to pump during the day, at the higher tariff rate.

RH Yes.

BJ And all the boffins down in the accounting section used to throw bananas at him because they always reckoned that he should have been able to do it cheaper. But, of course, if he didn't allow enough ...

RH Yes, no one would thank him if Kalgoorlie ran out of water.

BJ Or anywhere! Yes. On the other hand, if they had too much water, the accountants jumped, and he was in a very difficult situation.

RH Yes.

BJ And a very hard one to actually estimate, because you were working on information supplied from another source, which wasn't a hundred per cent accurate. I mean, weather people are never a hundred per cent.

RH No.

BJ You *cannot* be one hundred per cent. It's not a scientific problem.

RH It is a science, but an inexact science.

BJ Yes. Have you read Bob Southern's book?

RH No, I haven't found it yet.

BJ Oh, it is *fascinating.*

RH I am looking forward to it though.

BJ He doesn't talk just about weather. He talks about a few experiences that he's had, but he talks about the fundamentals of weather, where it is really purely and simply the physics of transfer of heat on the ground.

RH Yes.

BJ And how is the heat transferred? It's transferred through air, it's transferred through water, and it's transferred through land. And when you think about it, and I've never thought about it until I read the book, the simplicity of why we have weather changes is fundamental. The thing that is not easy [to predict is] why we have, and when we have, cyclical changes. Why sometimes you can have unseasonal weather condition in summer and winter and things like that.

RH Coming back to this business of starting the pumping stations, the operators decreased the resistance, did they, as they came onto full load?

BJ Yes, as they came on.

RH Did they do that actually at the pumping station.

BJ As the motors built up speed, then they were able to increase the voltage to keep within the current – maximum current draw, and go to that. No, obviously, the current that I gave them – that in-rush current – was well in excess of the maximum load of the motor.

RH Yes.

BJ I mean, let's say the maximum load of the motor was 150 amps, then it may be that I said the maximum in-rush current could be 250 amps.

RH Yes.

BJ So he had to limit that in-rush to 250 and then, as the thing came up to speed, so the current would drop off. They could change the resistance at the station. Nowadays it's most likely done with computers and all manner of other sorts of arrangements which I am not up to date with.

RH Now initially, did they have to have someone actually at the pumping station doing it.

BJ Well, no. It would have been, I think, a completely automatic set up. When you pressed the starter on the motor, this resister came in and it slowly turned round or whatever. Oh, we've got buristers now and all those other sorts of solid-state controllers and they most likely arrange for the motors themselves to be wound in a different way and to operate, but I don't know the details of that. No. I've never studied that.

RH Yes.

BJ I am sure they have, because it's amazing what they do.

RH [Could we have a look at the days before] the country towns along the pipeline were taken over by the SEC ?

BJ Yes.

RH Before the SEC they had diesel powered generators, didn't they?

BJ Yes.

RH In places like Southern Cross, Cunderdin and Kellerberrin?

BJ Most of the supplies were direct current.

RH Yes.

BJ Very few were alternating current. They were direct current, and one of the jobs that I had when I joined [the SEC] was to change these town supplies over from direct current to alternating current.

RH Why did they have direct current ones? Were they cheaper?

BJ In the early days

RH They didn't have to transmit long distances.

BJ No, no. In the early days, they were obviously cheaper. Yes. The problems we had with each of these diesel stations were, of course, that the load was growing, and the load varied during the cycle of a day or a week. Weekends were lower than the week days. And they had to bring machines on and off. Now one of the basic elements with a diesel engine is that a diesel engine *has* to run, or to put it another way, to be most economical, a diesel engine should run almost at full load, maximum temperature. Running a diesel engine at light load is not a good thing. Its temperature is not high enough and its wear becomes greater. The hotter you get the diesel engine, the more up to full load you can get it, the more efficient the whole thing is. So, as the load went off in the evenings, the operators used to have to bring in the smaller units, shut down the larger units and then move them up and down. And in most stations, we didn't inherit five identical units.

RH {laughs} No!

BJ It was two big ones and three small ones, or something of that nature. You sort of had to juggle the arrangements to go through. Fortunately, diesel engines were able to be started and shut down pretty quickly. There weren't a lot of problems. On the other hand, with a steam turbine, if you started from cold, you had a minimum, I think ... well, Peter Lowe would know, two, three, four, five hours! You've got to heat the water up in the boiler, turn it into steam. When you've got the steam, then you put the steam through the unit. Even when the steam's up to full temperature – and you can maybe borrow the steam from a steam range, because you've got other units there – then start turning the motor over and slowly heating it up so that it's heated up equally all the way around and you don't end up with a bent shaft. When you've got that up to temperature, then you can start to load it up.

RH So there weren't any steam turbines outside the SEC system, were there? What was the one in Kalgoorlie, the private one there?

BJ When we took the power supply over, there was no steam. There might have been some steam in the early days.

RH Right.

BJ But ... yes, there could have been steam in the very early days there, because, I mean, they had steam for the pumping stations, so I wouldn't be at all surprised if the original was steam, but then it was changed to oil, diesel, and diesel fuel.

RH Oh.

BJ Narrogin was a 40 cycle town. We had to change that to 50. That was the same as Perth. It was a new experience for me. I hadn't done a frequency change before.

RH Were there a lot of country towns on 40, the same as Perth?

BJ No, no. Well, not to my knowledge.

RH Only Narrogin?

BJ Narrogin, yes.

RH Oh.

BJ And Wagin was changed over before I joined. I joined the SEC in 1951. Wagin had already been changed over. Then, I think I'm right in saying that Margaret River had been changed over. It was already AC 50 cycle. When I took over, also, Albany had already been changed over to 50. It had been running on 50 cycles.

RH Yes, what date did you take over? I can't remember now.

BJ What?

RH In the south west, yourself.

BJ Did I start?

RH When did you take over as 2 i/c in it?

BJ I became second in charge in 1968 – March '68. And I was there until July '75, and then I was moved away from distribution and I had four departments. I had all the diesel stations over the whole country. I had all the transport. I had the electric metering and measurements department and then I had a construction and workshops department – civil, mechanical and electrical with a team of 500 in that department alone. My staff was about 1000 and the total staff for the SEC was 5000.

RH Amazing.

BJ And not once in my time did those men go on strike because of something *I* did.

RH That's a nice thing to remember.

BJ A few of them went on strike for something else. I had a very good relationship with Jack Marks and we became great friends, after he had put me in the court. Well, I

had been in court and cross-examined him for an hour. So he cross-examined me for an hour one day! {laughter}

RH Oh!

BJ He was a very honest man. He was a born actor. I mean, he swore like a trooper when he talked to the men, but behind the door, he was a very, very honest man and a very, very compassionate man, actually.

RH Yes.

BJ Lovely.

RH So coming back to the country towns, looking at Cunderdin, for instance. You changed it over to AC – that was before the actual transmission line power arrived. Is that right?

BJ I don't know what happened. The power went to Cunderdin whilst I was based in Bunbury.

RH Did it? Yes.

BJ Yes. The country system developed into four regional centres.

RH Right.

BJ The first two were the South West, based in Bunbury and the eastern one, based in Northam. [Originally these had been combined] as 'The South West and Great Southern'.

RH Oh yes.

BJ That was my first area when I became District Engineer, I had to look after both of those [as a combined district]. Then they divided that into South West *and* Great Southern, and the Great Southern originally had its headquarters in Wagin, and then they moved down to Albany later on. Then when we built the line to Geraldton or, rather, prior to us building a line to Geraldton, we started a Northern area in Geraldton. There was a district there. And then there was a North West one, a fifth one which was based in Port Hedland, and the [people there] looked after.

RH What sort of diesel units were there up there?

BJ The district engineer at Port Hedland, he was looking after distribution at Port Hedland and at Broome and Derby, but not the diesel stations. The diesels came under me.

RH Oh yes.

BJ Now there was an interesting thing about that -- it's a sideline. We put some new engines in Port Hedland and they were MAN German engines and the **stellite** on the valves was starting to fall off. This is a seal on the big valves. And these were fairly large ones. The crankshafts were 35 feet long.

RH Oh! {laughs}

BJ 1500 to 1800 horsepower. Anyway, the stellite came out, and when this happened there was a fault and the engine would trip. Quite often, we still had sufficient capacity running. Not every diesel was fully loaded, there was always enough to lose one engine. But, as it happened, immediately this thing shut down there was a sort of sudden surge. The distribution people had set their under-frequency protection on their sub-stations. They had frequency meters – at 50 cycles, everything was all right, at 49 and a half cycles, a certain number of circuit breakers would trip, to reduce the load. When it got down to 49 cycles, some more would trip. And when it got down to, say, 48 cycles, then the whole lot would shut down.

Now, you made sure that the hospitals were on the second last one to shut down – or the last ones to shut down. And that happens exactly the same here in Perth. But, anyway, whenever this happened, the distribution people used to lose a lot of these circuits, one after the other, when this fault occurred, and they kept saying to me: *Oh no, no, you've got your settings wrong. Because we had capacity to cover it, You've got the settings wrong in the power station.* So I said, *Oh no, they are quite all right.* And this went on and on and on.

Anyway, Tom Cook had got very annoyed about it, and rightly so. I said, it's your settings that are wrong, not ours, at the power station, and so Bob Booth, Dr Bob Booth – he was OC Engineering. There was Finance and Engineering and he was top of the Engineering in the SEC -- called a meeting. Bob Booth at the head of the table, Tom Cook and all the protection boys and distribution boys down one side and Bob Perry and I were on the other. We were the diesel men. And he threw the book at us and I said: *No, we're quite all right, Dr Booth. I am quite happy with ours.* We actually made a check with – not Alice Springs, north of Alice Springs – Katherine.

RH Right.

BJ And one or two other places that have got a similar set up to here and our settings are quite all right.

And he said, *I've arranged for this.*(He'd come from SECV) *I've arranged to get meters over and one thing and another, at no cost,* and one thing and another.

And then I started to talk to the supply boys and I said; *Well, you know, I am sure it's your settings that are wrong.* Because I didn't know what their settings were.

And he said; *We always use these settings.*

I said, *I beg your pardon.*

Oh yes, we always use these settings.

I said, *Well, that's the cause of your trouble. You've got the wrong settings.*

Why? We always use them.

I said, *You've designed the settings for steam turbines where the generators are running at 3000 rpm. Our diesels, they are running at 426 rpm. The inertia of our diesels is such that we have what we call a droop. When you have a few faults, you get a droop of about four per cent. Oh down she goes, and up she goes. It doesn't trip off, and everything's okay. You've got to set number one not at 49 and a half.*

Set the number one at about 48 and the number two at about 45 cycles, because the diesel will pick it up and carry it.

Oh, oh, oh! {laughter}

Richard, they didn't understand the basic fundamentals! *Highly* qualified people doing all this and no idea! It was so interesting! And it happened other times. We had another occasion with a gas turbine – the one in Geraldton.

We went up to start it and I wanted to see, I wanted to try out, that it could carry Geraldton, Three Springs and Moora – the three loads. And so we arranged this for one o'clock one morning and all the protection boys came up and the construction boys. I wasn't in charge of the machine. I was tied up with the distribution and made sure it was right. Anyway, because we've got long lines, they act like a condenser, [Between] the lines and the ground, you get capacitance. Now one of the problems is that in a gas turbine and in an alternator, you actually supply power and you can control the voltage that comes out by the excitation of the actual alternator. Anyway, they set it up and away they went. We carried the town of Geraldton, no worry. We didn't shut anything down; parallel the system; carried the town of Geraldton. Then we altered the excitation on the alternator and got it down, and then we slowly started to carry the load of Three Springs, which is a third of the way down the line.

But, I knew that, not only did we carry the load, but the voltage at Three Springs was starting to climb *outside* the plus or minus ten per cent, and I said:

There's something wrong in this switching schedule. We are doing the wrong thing. You have to shut it down.

Oh, we can't.

I said: *I'm sorry, I am not prepared* – and I am exercising my responsibility here – *to jeopardise consumers' equipment.*

RH {laughs} Yes. That would be very popular.

BJ *Refrigerators and things, just because of this. Shut it down and we will go and see what is wrong.*

Anyway, they shut it down. It was the Thursday night, and we shut it down, and we all went back. I went back to the motel. David Martin, my district engineer up there, came into my motel and we sat down and we said, let's fundamentally look at it. Real power, active power is fuel. That's more and more less fuel. Reactive power is excitation, is voltage. Because of the line, we have to reduce the voltage on the excitation – on the alternator. So after about four coffees and about two hours discussion, by five o'clock in the morning, we were agreed that they had turned the control the wrong way around. The switching schedule turned the control the wrong way around.

So we agreed to meet at eight o'clock next morning, Friday morning, and I said: *We're going to do it again. Now, when everyone's awake.*

And I said: *It won't go wrong! We reckon we're right.*

But, I don't.

I said: *Come on, I'm not coming back up here again just to do this. We are going to do it. Come on, start it up.*

So they started up and did it. Ted Strong was the protection man – very nice man – later on became in charge of Muja power station – and we were right. Yes, they had it the wrong way around, and wound it back, because the excitation was being provided by the capacitance of the line, as we took it on. And we took Three Springs on, and we got the Moora load, and I wanted to see how far back we could get towards Northam terminal, which is the connecting point to the metro area, and we got about two-thirds of the way back, and then there was a stop – there was no more.

So we couldn't take the whole line there, which was very interesting, which meant that if we lost supply, we had to open it from Moora down to Perth. We had to open that bit of line.

RH I was going to ask you, what actually was initiated the SEC taking over towns like Cunderdin and Merredin. Was it because power had to be provided for the pumping stations?

BJ No, it was to provide a network for the country, the whole country system. A network was set up to shut down the diesel stations and build a grid, which would shut them down and connect them to the coal-fired steam stations, which meant that the cost of generating electricity would be much lower. And the tariffs would drop. For example, Brunswick, out of Bunbury, coming back towards Harvey, had power provided by a diesel station run by the Harvey Shire, {laughter} They were then paying 1/6 a unit for electricity. Now when they got onto the South West Power Scheme grid, it was the 7p, 6p, 5p, 4p. So the country towns benefited by it.

RH Yes. And the white goods industry did quite well out of it as well, I guess.

BJ The which one?

RH The white goods.

BJ Oh yes.

RH Refrigerators, washing machines and all that! {laughs}

BJ Of course. When I was starting the changeover, only about every second house had a refrigerator and only one in four had washing machines. And what we did, by the time we got to Katanning, which was one of the last ones that I was involved in, everyone had a refrigerator, and everyone had a washing machine. {laughter} But, what we did was, in the early days, we bought an AC motor that would fit in, in place of a DC motor for the fridge or the washing machine. We took the DC motor out and then, when we knew the next town was going over – maybe within the next two years – anyone that was buying a new fridge, bought it with an AC motor, but of course the town was still on DC. They brought the AC motor to us, and we gave them or loaned them a DC motor, and we put the name of the person and the street where they lived on their motor and, when the changeover came, they got their original motor put back into their machine.

RH Right.

BJ So that saved us having to buy a new part every time.

RH It must have been a big storage area for ...

BJ Oh yes, it was.

RH AC motors! {laughs}

BJ Well, [it was straight forward] for refrigerators and things of that nature. The more difficult cases were the dentists with their variable speed drills. In fact, there we didn't buy motors. What we did was we just put a little rectifier unit in and they plugged the rectifier unit into the AC and got DC out the other end.

RH Right.

BJ Because that's very much a variable speed control. The old dentist's drills...

RH {laughs} They weren't like the modern high speed drill.

BJ They didn't go very fast at all. They only went about 300 rpm {laughs} – their drills!

RH Yes, the old ones. Yes, I remember them going so slowly.

BJ Grind! Grrr-rrrr! {laughs} Feel the vibration! Yes. So, the changeover was an interesting exercise.

RH So, the Public Works Department had to fit in with the SEC's country grid formation as far as electrification was concerned.

BJ Yes, yes.

RH And the only pumping station that wasn't electrified in the early days was Dedari. That wasn't electrified until '84. Was that when the power came to Kalgoorlie from Muja?

BJ Dedari, '84. Dedari was a new one, wasn't it?

RH Yes, they put in a new diesel station.

BJ Oh yes.

RH Near the old pumping station No.8 – the steam one. And then when the power came there, they switched to electric in '84.

BJ Right, yes, yes. So that would have been '84. The Kalgoorlie line ... 75 ... yes, the Kalgoorlie line would have been in by that stage, yes. Definitely. Yes.

RH It must have been a bit expensive to have to replaced the steam with diesel and then gone to electric! {laughs}

BJ Well ...

RH These particular diesels were supposed to be very unreliable. The operators would have been glad to have got rid of them.

BJ Yes. Well, we recycled the diesels. I mean, for example, the diesels that were used for the guns at Rottnest during the war ...

RH Oh yes.

BJ When they were taken out after the war, they went to Corrigin. And then when Corrigin was connected to the grid, they were disbanded and got rid of. The problem was that what we needed was bigger diesels in usually the larger stations and, as I mentioned in Port Hedland, we put in originally some 5.6 megawatt sets and then we put in some 15 megawatt sets. Very large ones. But they were new sets.

RH In some cases the mining companies put in their own power stations, didn't they?

BJ Mining companies, yes. Still do. Still do to this day, yes. No, Mount Newman's got its own one. I don't know whether the SEC or Western Power runs the distribution in Mount Newman now. We do in Karratha.

RH Oh.

BJ We bought power from the mining company there. A portable thing.

RH Well, I don't expect the mining company's got a power line from Mount Newman to Port Hedland, would they? It's a hell of a long way.

BJ No, no.

RH They have the gas there now, I suppose.

BJ Yes, yes. And we buy power now at one of the stations up there. Oh, which one is it?

RH Red Hill, is that the one at Port Hedland?

BJ Yes, I think it is the Port Hedland one. There's another one a bit further south that we take off from, and they've got a power line through. I'd have to look at my map again and see what the network is.

RH So, coming back to the earlier electrical pumps for the pumping stations. On the Goldfields Water Supply, you said that you sometimes had to put in a transformer as well. Well, did the Public Works have to pay for their transformers, or did the SEC do that? Or did they make a deal with it?

BJ I wasn't involved in the details, but I think the SEC paid for the earthing, as far as I know. As far as I know, the arrangements were that we bought the equipment and everything else. I wasn't tied up with the financial implications of it, myself. But if we had followed the normal procedure we would have paid for the whole thing.

RH Yes, I don't want to get too involved in the financial side just yet, anyway.

I think I had better not take up any more of your time, Bruce. Thank you very much. That was very interesting.

1 November 2002

WATER CORPORATION

GOLDFIELDS WATER SUPPLY HISTORY PROJECT

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